

Fig. 1. Transmission Electron Microscope (TEM) study of potatoes resulting from addition of W and Pt to the superconductor  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  (Y123). Dark, roughly circular objects are potatoes of  $(\text{W}_{0.5\pm 0.1}\text{Pt}_{0.5\mp 0.1})\text{YBa}_2\text{O}_6$  of diameter circa 200-300 nanometers.

Fig. 2. TEM study of potatoes resulting from the addition of Mo and Pt to the superconductor  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  (Y123). Dark, roughly circular objects are potatoes of  $(\text{Mo}_{0.5\pm 0.1}\text{Pt}_{0.5\mp 0.1})\text{YBa}_2\text{O}_6$  of diameter circa 200 nanometers. One of the 2 particles in the lower left is  $\text{Y}_2\text{BaCuO}_5$  (Y211), a non-superconducting phase of  $\text{YBaCuO}$ .

Fig. 3. TEM study of potatoes resulting from addition of U and Pt to the superconductor  $\text{SmBa}_2\text{Cu}_3\text{O}_{7-\delta}$  (Sm123). Dark, roughly circular objects are potatoes of  $(\text{U}_{0.6\pm 0.1}\text{Pt}_{0.4\mp 0.1})\text{SmBa}_2\text{O}_6$  of diameter circa 200-400 nanometers. This sample has been irradiated with thermal neutrons resulting in fission of some of the  $^{235}\text{U}$  isotope. Fine lines in center of upper third of picture are damage lines created by fission fragments.

Fig. 4. Electron Microprobe study of potatoes resulting from the addition of U and Zr to the superconductor  $\text{NdBa}_2\text{Cu}_3\text{O}_{7-\delta}$  (Nd123). Bright very small objects are potatoes of  $(\text{U}_{0.5\pm 0.1}\text{Zr}_{0.5\mp 0.1})\text{NdBa}_2\text{O}_6$ , of diameter circa 400 nanometers. Larger, light objects are  $\text{Nd}_4\text{Ba}_2\text{Cu}_2\text{O}_{10}$ , a non-superconducting phase of  $\text{NdBaCuO}$ .

Fig. 5. Electron Microprobe study of potatoes resulting from mixing the pre-reacted compound  $(U_{0.6}Pt_{0.4})YBa_2O_6$  to powders of the superconductor Nd123, followed by texturing of the mixture. Small bright objects are deposits of the UPtYBaO compound.

*percentage (by weight) of*

Fig. 6. Critical current density,  $J_c$ , vs.  $\% UO_4 \cdot 2H_2O$  (weight) added to  $YBa_2Cu_3O_{7.8}$  (Y123).  $J_c$  was calculated from maximum trapped magnetic field in single grains of Y123, 2 cm diam. x 0.8 cm long. Note that as more U is added, trapped field increases by 60%. If  $J_c$  were measured at constant field, as is usually done, the enhancement factor in this measurement would significantly exceed 2.0.

Fig. 7. Ratio of trapped field with X%  $WO_3$  to trapped field with no  $WO_3$ .  $WO_3$  is added to Y123 powders plus 1.25% Pt, before texturing.

Fig. 8. Schematic showing how potatoes are buried in and surrounded by oxide superconductor.

Fig. 9. Microprobe studies showing texturing effect of  $ZrO_2$  addition to Nd123. Top left no  $ZrO_2$ ; top right 0.04% (wt)  $ZrO_2$ ; bottom left 0.1% (wt)  $ZrO_2$ ; bottom right 0.2% (wt)  $ZrO_2$ .

Fig. 10. Schematic showing three classes of pinning centers. Top shows small # of large deposits of Y211. Second shows refinement of Y211, providing a first class of pinning centers, and small deposits containing foreign as well as native elements (e.g., A, B, RE, BaO), which provide a second class of pinning centers. Bottom shows lines of damage caused by fission fragments, which provide a third class of pinning centers.

TOP SECRET



100nm

TEM

Fig 1

60% Y211 + Y123 + 1.0% Pt + 0.36% WO<sub>3</sub>

10039257.1003401



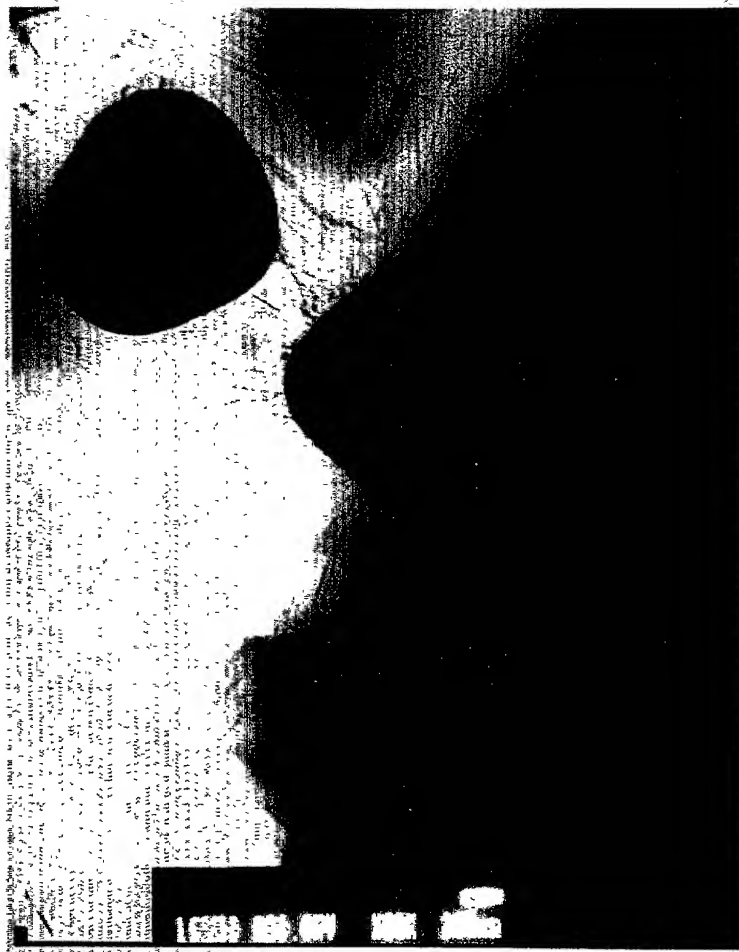
60% Y<sub>2</sub>O<sub>3</sub> + Y<sub>2</sub>O<sub>3</sub> + 0.5% Pt + 0.3% MoO<sub>3</sub>

Fig 2

TEM

Indistinguishable sphere, left + low, one  
is Y<sub>2</sub>O<sub>3</sub>, other is MoPtS

1003927 123404



TEM After Irradiation Fig 3

20% Sm<sub>2</sub>O<sub>3</sub> + Sm<sub>2</sub>O<sub>3</sub> + 0.5% Pt + 0.15% / 250 PPM  
 $^{235/238}\text{UO}_2 \cdot 2\text{H}_2\text{O}^*$

Very thin lines in center, upper  
third are damage tracks  
left by  $\alpha$  fission

10039257-12104  
T01021-256600T



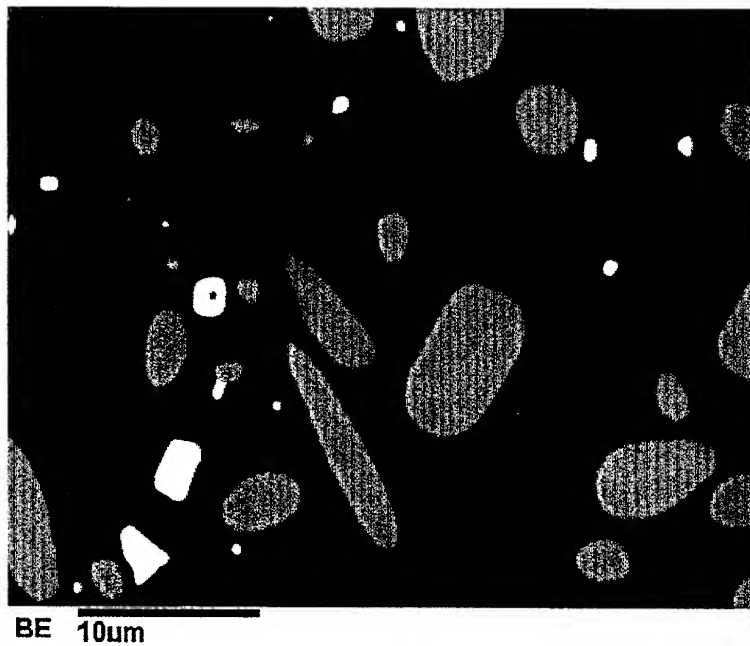
BE Nd1.8+0.15U+0.048Zr 10um

Microprobe

Fig 4

20% Nd422+Nd123 + 0.15%  $\text{UO}_4 \cdot 2\text{H}_2\text{O}^*$   
+ 0.048% ~~2~~  $\text{ZrO}_2$

10039957 123104



Microprobe

Fig 5

20% Nd422 + Nd123 + 0.44% <sup>238</sup>(U<sub>0.6</sub>Pt<sub>0.4</sub>)YBq<sub>2</sub>O<sub>6</sub>

Y-5

Small bright area

Y-5

i.e., U containing deposits



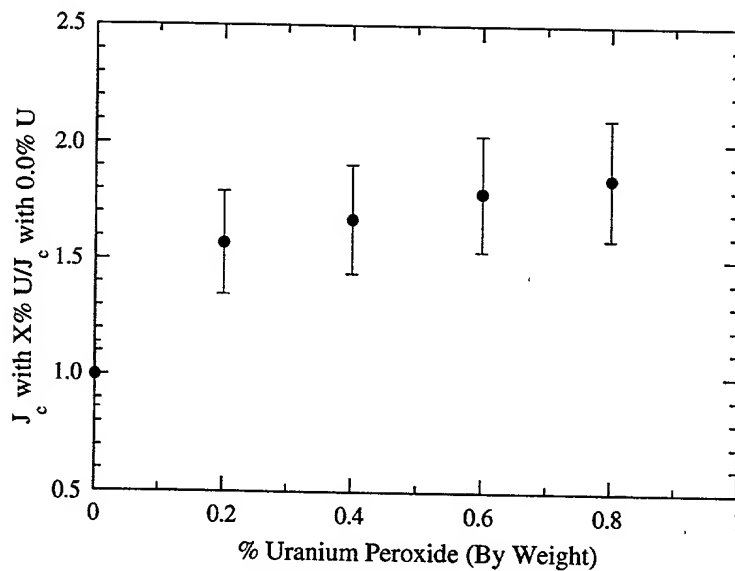
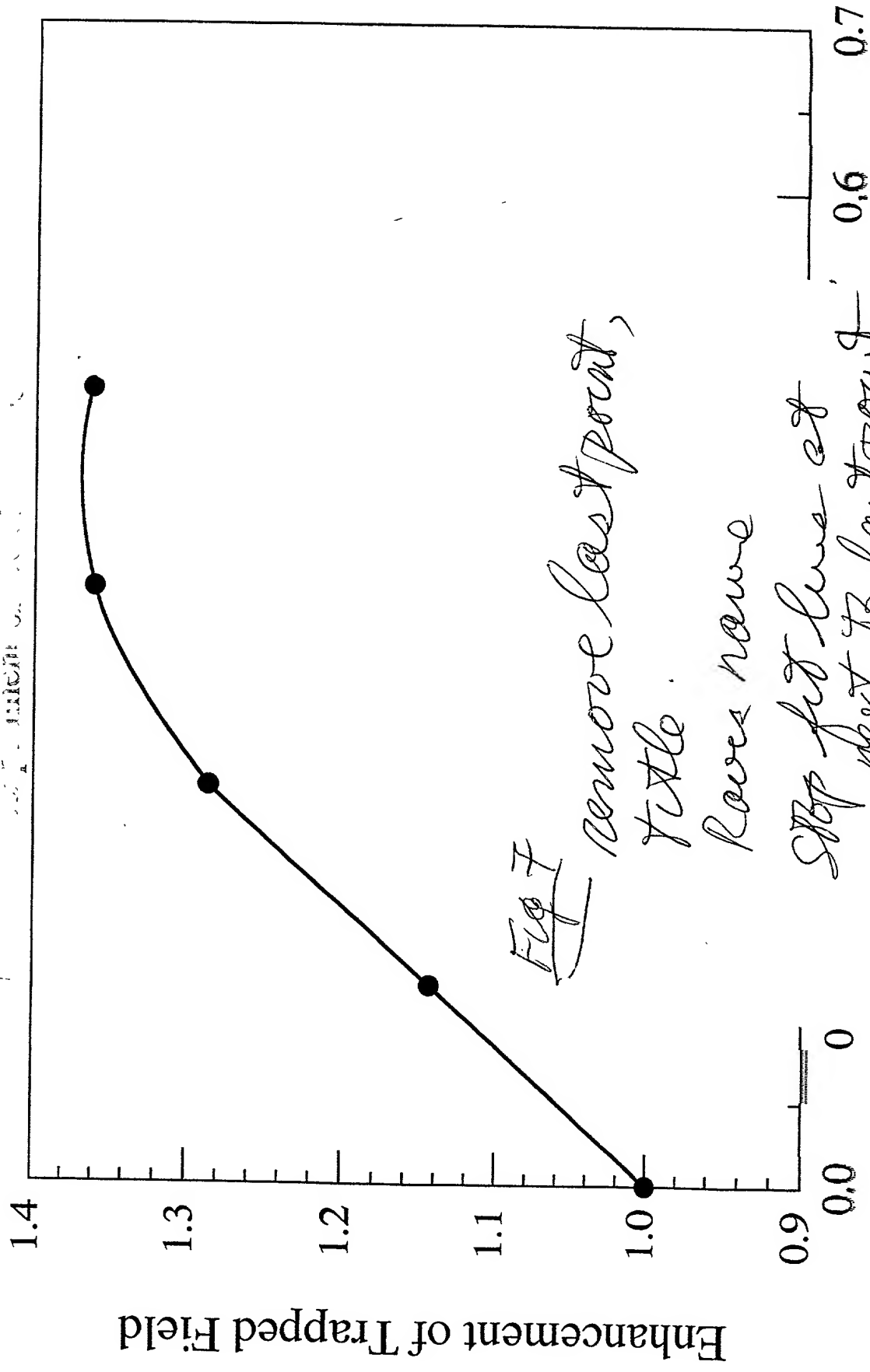


Fig 6  
 60% Y211 + Y123 + 0.5% Pt + Varying%  $UO_4 \cdot 2H_2O^*$

$J_c$  calculated from field plots and J. Liu's Program

Field Coiled @ 2 Tesla

2 cm Samples



10092257 123104

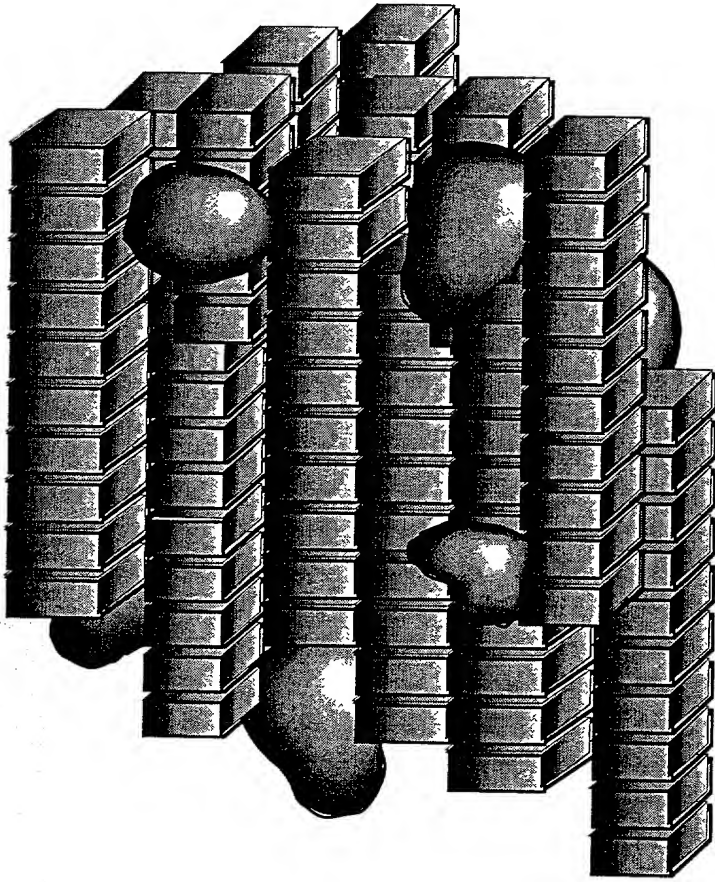
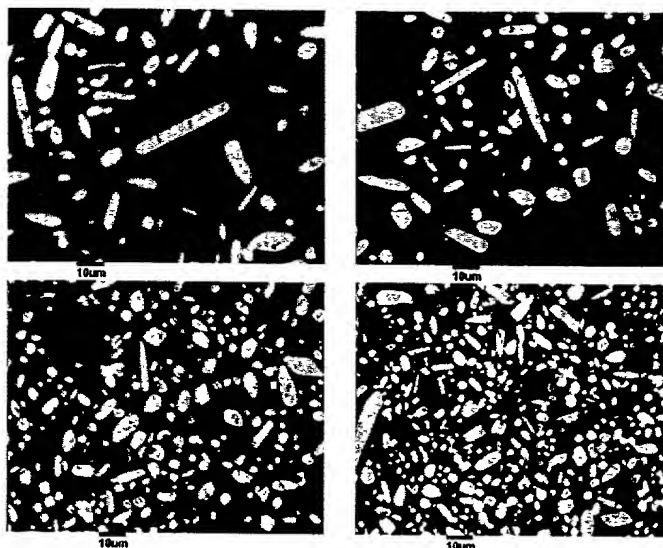


Fig 8

10039237 123404



Micrographs

Fig 9

Top Left : 20% Nd422 + Nd123

Top Right : 20% Nd422 + Nd123 + 0.04% ZrO<sub>2</sub>

Bottom Left : 20% Nd422 + Nd123 + 0.1% ZrO<sub>2</sub>

Bottom Right : 20% Nd422 + Nd123 + 0.2% ZrO<sub>2</sub>

1003935-101

(a)

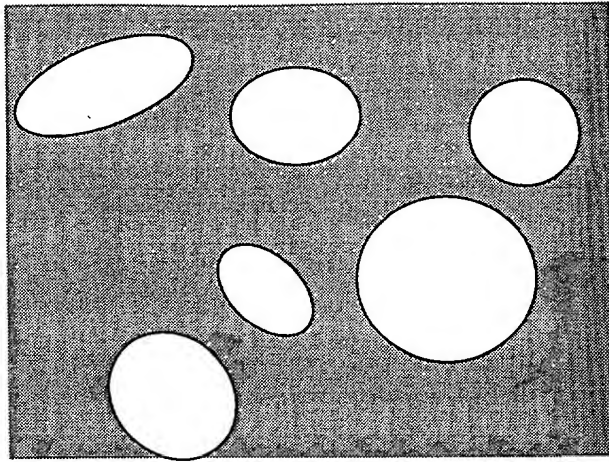
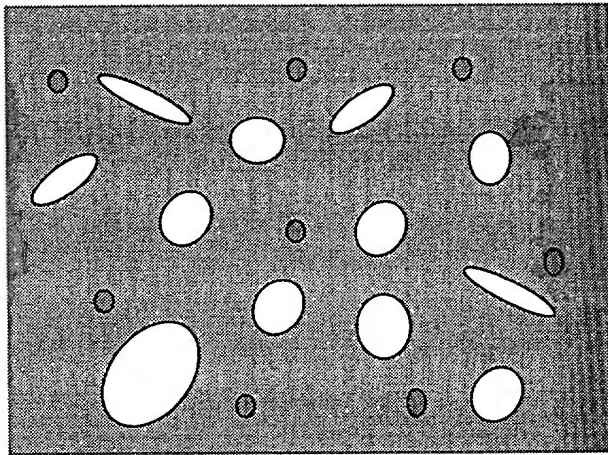
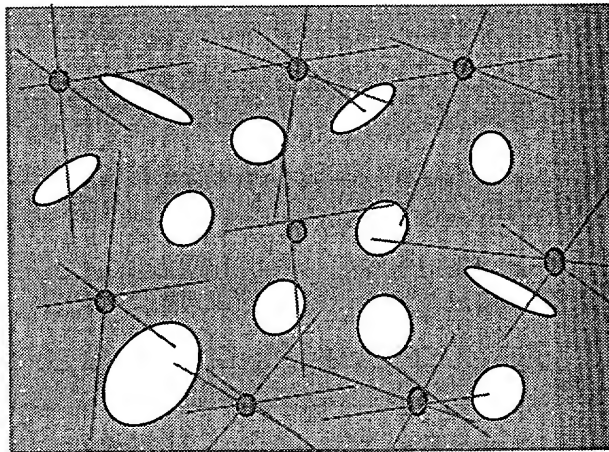


Fig 10

(b)



(c)



RE123



RE211



UZrNdBaO

Fission Fragment  
Damage

— 1  $\mu$  m